QUANTITATIVE ASSESSMENT OF API GRAVITY IN LIQUID PETROLEUM HYDROCARBONS USING DIFFUSE REFLECTANCE SPECTROSCOPY

Correa Pabón, R.E., Souza Filho, C.R.

Institute of Geosciences, University of Campinas (UNICAMP)

ABSTRACT: Diffuse reflectance spectra of forty liquid petroleum hydrocarbon (PHC) samples have been obtained in the Visible, Near Infrared and Short Wave Infrared (VNIR - SWIR/ 350 – 2500 nm) and Middle Wave and Long Wave Infrared (MIR / 2500 – 15000 nm) regions. VNIR – SWIR measurements were carried out using an ASD FieldSpec-4 standard-resolution spectrometer and a Spectralon panel. The illumination source was an ASD Muglight (high intensity source probe with halogen light source) that is adapted for indoor lab diffuse reflectance measurements. Measurements were performed six times at distinct locations of the sample for averaging purposes. Between every measurement, the sample was rotated 60°. Each individual measurement was an average of 100 internal scans. The MIR spectra were carried out using a Thermo Electron FTIR Nicolet 6700 spectrometer. The spectrometer was equipped with a trough plate for Smart ARK accessory with ZnSe window and an angle of 45°. A 1ml of PHC was placed in the trough plate and scanned 150 times, in the frequency (wavenumber) range 4000 – 650 cm^{-1} at a resolution of 1 cm^{-1}. The background spectrum was collected before every sample measurement, to remove the effects caused by the instrument and atmospheric conditions, so the peaks in the final spectrum are due solely to the sample. Spectral characterization of these PHCs was performed in the whole region, and the main absorption bands and intervals were identified. Some PHC absorption bands can be sensed by instruments currently in operating airborne (e.g. ProSpecTIR, AVIRIS, SEBASS, HyTES); and orbital (ASTER, WorldView 3) platforms, which could also be achieve by future sensors, such as EnMap and HysPIRi. lMultivariate analysis such as principal component analysis (PCA) and partial least squares (PLS) regression analysis have been used to evaluate the ability to predict the API gravity from diffuse reflectance spectra in VNIR – SWIR and MIR regions. An apparent correlation is shown to exist with the spectra in these regions and the API gravity of PHC. PCA allowed to distinguish three different groups related to the PHC's density. PLS carried out in the dataset allowed to obtain predicted models to determine the API gravity degree of PHCs from NIR – SWIR and MIR spectroscopy. Therefore, these regions have the potential to be a rapid and nondestructive method to estimate the API gravity in PHCs.

KEYWORDS: DIFFUSE REFLECTANCE, LIQUID PETROLEUM HYDROCARBON, API GRAVITY.